UNITED NATIONS **E**

Economic and Social Council

Distr.
LIMITED

E/CONF.87/L.11
30 March 1994

ENGLISH ONLY

THIRTEENTH UNITED NATIONS REGIONAL
CARTOGRAPHIC CONFERENCE FOR ASIA
AND THE PACIFIC
Beijing, 9-18 May 1994
Item 4 of the provisional agenda*

COUNTRY REPORTS ON THE CURRENT STATUS AND ISSUES OF SURVEYING, CHARTING AND MAPPING AT THE NATIONAL LEVEL: NEEDS AND REQUIREMENTS VERSUS REALITY IN THE REGION

Cartographic activities in New Zealand, 1991-1994

Paper submitted by New Zealand**

* E/CONF.87/1.

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INTRODUCTION

This report describes the progress and development of cartography in New Zealand during the period 1991-1994.

PART 1: CARTOGRAPHIC ACTIVITIES OF THE NEW ZEALAND DEPARTMENT OF SURVEY AND LAND INFORMATION

The Department of Survey and Land Information (DOSLI) was formed in 1987 when the Department of Lands and Survey was disestablished. This occurred as part of a widespread government restructuring programme designed primarily to separate statutory and regulatory functions from potential and existing revenue earning operations. Central government departments involved in the management of natural resources were also integrated through the restructuring programme to consolidate environmental management, policy development and monitoring. These reforms effectively removed conflicts of interest, allowed operational departments to resemble some aspects of private companies, and introduced a requirement to function according to cost recovery or user pays principles. Several State-Owned Enterprises were created, some of which were subsequently sold in the government's State Asset Sales programme, while essential service delivery agencies remained within the state sector.

The new department is the principal government civil and military agency for surveys, mapping and land information. The current state sector environment demands the provision of quality products and services by the department. Consequently, DOSLI has focussed on anticipating and responding to government, local authority and private clients needs, technological developments, and the changing requirements of New Zealand society.

These functions provide the basis for:

- secure land tenure and property rights, and the use and management of land related resources;

- support for the management and monitoring of the environment, communications, security, social, economic, commercial, administrative and government systems in New Zealand and extended as appropriate to the South Pacific and Antarctic regions; and

- assistance in the implementation of the government's policies on indigenous peoples land rights issues as guaranteed by the Treaty of Waitangi, the devolution of service delivery functions to Iwi Authorities, and the transfer of land assets.

There is a responsibility to maintain several major national land record systems that are central to the maintenance of secure land tenure, security and safety, and for general national and public benefit from the carefully planned and sustained use of land resources.

These systems include the:

- Survey control and cadastral system;
- Cadastral survey records and mapping;
- Topographic mapping.

The department is also required to administer or dispose of Crown land not allocated to a government department or State-Owned Enterprise, and provide policy advice to the government on land related issues.

Mention was made in the last report of the mapping activities of the Department of Scientific and Industrial Research. That department ceased to exist in 1992 and its mapping functions were taken up by DOSLI.

THE LAND SURVEY SYSTEM

New Zealand enjoys the benefits of an integrated survey system that was introduced in 1876. This is achieved by:

- Relating every survey to one control system which provides the positional framework for all measurements.
- Standardising procedures, accuracies and records.
- Providing a single source of administration through DOSLI and servicing of the survey industry by a professional body.

Cadastral surveys are defined and governed by the Survey Regulations which are regularly reviewed to meet the changing needs of the land survey system and new technology. The two plan system (survey and title) is being maintained and retrieval of data is readily available through a microfilm system. With the ever increasing use of sophisticated technology in computers and measuring equipment, survey methods and standards are constantly under investigation. All new approved survey data is recorded. This forms the basis for the production of cadastral maps. Approximately 20,000 plans are added each year to the land survey records of the department. These surveys are predominantly undertaken by registered surveyors in private practice.

GEODESY

Utilising GPS technology, a major investigation is presently underway to establish the relationship between the nation's existing geodetic datum (as determined in 1949) and the WGS 84 reference system.

Projects are being undertaken to determine accurate measurements of selected geodetic stations on either side of the Australian and Pacific tectonic plates. This work is being carried out in cooperation with international agencies. As further data is accumulated, it is hoped that a more reliable detection of tectonic movement and associated earth deformation will be established.

Second and third order control surveys have continued, particularly in areas where inadequate reliable geodetic control previously existed. This upgraded work is required to provide a more accurate foundation for digital cadastral database development. These surveys have often been undertaken using a combination of conventional and GPS survey equipment.

A differential navigation service has been established to enhance the accuracy performance of users' remote GPS receivers. Three strategically placed base stations provide a ± 2 - 5 metre real time or post-mission accuracy for any location within New Zealand.

A new survey network adjustment package has been developed which accommodates conventional observations and measurements as well as GPS data.

The national geodetic database is being expanded to include urban and rural standard marks as well as geodetic trig stations and benchmarks. This database is being converted to a new operating environment which will significantly enhance its graphics capability and its association with allied cadastral, photogrammetric and topographic databases.

CADASTRAL MAPPING

New Zealand has complete national cadastral map coverage at scales ranging from 1:1000 to 1:50,000. These total approximately 18,000 maps which are hardcopy, manually drawn and maintained. They are updated daily on approval of new subdivisional plans or on advice of changes to the textual data.

The department has also built a Digital Cadastral Database (DCDB) comprising data on land parcels throughout New Zealand with respect to their geographic location, shape, area and legal description. The database also has a layer defining statistical meshblocks, the smallest geographical collection unit for census and socio-economic data.

By the end of 1995 the DCDB will supersede the manual record maps as on-line enquiry systems are incrementally introduced throughout the country.

The DCDB is being widely used as the spatial base for local and regional government and public utility geographic information systems. It will provide the spatial framework for core land information systems comprising land valuation and land title data. It is being used to provide management and mapping support to administer New Zealand's electoral system, the redistribution of electoral boundaries, and mapping to support the nation's Census of Population and Dwellings.

TOPOGRAPHIC MAPPING

New Zealand has complete national coverage of topographic mapping. The published metric Infomap 260 series (1:50,000 with 20 metre contours) is available over the whole of the North Island and 80% of the South Island. Of the 305 sheets covering New Zealand, 285 have been published. The balance are in various stages of production. Some of the older 1:63,360 imperial mapping is still being used until the 1:50,000 is complete in 1996.

Photogrammetric production of the Infomap 270 series is nearing completion with all but eight sheets in the remote Fiordland area still to be mapped. Fully controlled aerial photography is available over this block. Infomap 270 mapping has been largely captured in graphical form with parts of the more recent areas completed digitally. This series is compiled at 1:25,000 scale, and provides the base material for all derived topographic mapping, with four sheets being reduced and combined to make one of the Infomap 260 1:50,000 series.

With the production of the Infomap 270 series drawing to a close, resources are being directed towards revision of the series. Revision to date has been carried out where necessary by field methods, but a planned programme is now being instituted that will see the 1:50,000 series sheets revised on an average ten year cycle. Methods used will vary with the character of the sheet but will be either by field or photogrammetric methods. Various new technology methods are currently being tested, the most promising of which appears to be the production of a digital orthophoto image at 1:25,000 as an interim step in the process.

Other official mapping series that fully cover New Zealand are the Infomap 262 series of 18 sheets at 1:250,000, and Infomap 242 comprising 4 sheets at 1:500,000. The NZMS 1 imperial specification series at 1:63,360 is being progressively withdrawn as sheets are superseded by the new 1:50,000 series.

DIGITAL TOPOGRAPHIC DATABASE

National coverage of 1:250,000 topographic data is complete, and capture of 1:50,000 data is progressing rapidly, with completion expected by 1996.

Both sets of data have been digitised by scanning the published map line sheets for contours, hydrography and roads. Point features have been added by manual digitising.

All data is fully structured, preserving the fundamental spatial relationships between features, including connectivity, adjacency and containment. Attribute data is added to all features.

The databases have been designed so that a purchaser requiring an update needs only to be supplied with changed or modified features which can then be integrated with the existing data.

PHOTOGRAMMETRIC PROJECTS

Since equipping seven analogue stereoplotters with GeoVision equipment in 1988, the variety of digital mapping work has greatly increased.

To meet a need for seamless topographically structured data for local authorities and utility organisations, 1:500 and 1:1000 scale urban land bases of major cities are being produced.

Vigorous marketing in the important forestry industry sector has increased the amount of mapping for a discerning clientele requiring clean datasets for forest management on GIS and CAD systems. The combination of new photography for feature extraction and historical photography for pre-planted height information, has proved a successful formula for foresters.

Further projects tailored to the needs of land planners involved with the sale of state assets have been carried out, and other work has included line of sight profiles for the telecommunications industry and tower positions and strip maps for power transmission engineers.

AERIAL PHOTOGRAPHY

The department's ability to sequentially cover New Zealand with 1:25,000 aerial photography has been greatly reduced in recent years through financial limitations. However, small key areas have been flown in conjunction with other projects and opportunities have been taken to join in with regional consortiums for the larger areas.

In November 1993 the department co-sponsored an aerial photography mission in Antarctica with the United States Geological Survey. Some 20,000 sq kms of photography was obtained primarily for topographical mapping, monitoring environmentally sensitive areas, and research around Ross Island and the Dry Valleys area. The department maintains a National Photo Library which holds most Crown and some private copyright photography. Some of this is now a valuable historical record. A computerised aerial photo index has been developed and information is currently being entered into this database.

DIGITAL IMAGE PROCESSING

A pilot project is currently underway to asses the viability of establishing a digital spatial database of land cover over New Zealand for resource management purposes, based on classification derived from satellite imagery. Satellite imagery has also been used in combination with cartographic line work in the production of image maps. Resources have been committed to further developing the department's remote sensing capabilities in the forthcoming year.

The quality of hardcopy map output for project mapping jobs, such as forest and highway construction mapping, has improved with the workflow from data capture to output now being totally digital. This fully digital process provides greater flexibility in map sheet design and consistency in map quality.

SCIENCE MAPPING

When the Department of Scientific and Industrial Research (DSIR) was reorganised into Crown Science Research Institutes in 1992, the DSIR's cartographic staff were transferred to the Department of Survey and Land Information, which now produces maps under contract for the Crown Science Research Institutes. These include: oceanographic bathymetry and sediment charts; gravity, magnetism and electrical resistivity maps; geological resources maps; soil and land inventory maps; and a range of charts for the New Zealand Meteorological Service.

Digital scanning and vectorisation services are also provided to enable existing graphic information to be utilised in geographic information systems.

Manual production techniques are rapidly being replaced by computer production and digital plotting methods. Many scientific maps are no longer lithographically printed, with more emphasis being placed on specialised report maps produced in low volumes by high quality inkjet plotter.

AERONAUTICAL CHARTING

Aeronautical Charting is now undertaken on a cost recovery basis. This has led to a review of standards and the development of improved quality assurance procedures.

The range of work carried out for the Royal New Zealand Airforce has reduced now that the client has to pay for chart production. Because of low usage rates, several chart series have been discontinued. Those that have been retained are being redrawn to more closely comply with the Air Standards Coordinating Committee standards.

The other major client is the Airways Corporation of New Zealand Limited. This is a State-Owned Enterprise that has the delegated responsibility, under the regulatory control of the Civil Aviation Authority, to carry out the commercial operation of aviation in New Zealand.

Most chart production and revision is now carried out using computers. The New Zealand National Enroute Navigation Chart, the regional and area charts, and overlays for the visual navigation charts are all produced digitally. There have been considerable savings in time and costs to the client, and products can be revised in a much shorter turnaround time.

The development, control and maintenance of a comprehensive database of aeronautical information has enabled other services to be provided to the industry. A major revision of airspace and the Airways Modernisation Project have utilised this data, together with digital topographic data that was also provided by the department.

TOURIST AND RECREATIONAL MAPPING

Forty five maps are currently produced showing national parks, forest parks, and other major tourist areas. Map scales range from 1:40,000 to 1:250,000 and most maps now have full colour on both sides, with supplementary photographs and descriptive test.

A committee including representatives from the Department of Conservation coordinates the design and collection of data for these maps, to ensure they are of maximum value to users.

HISTORICAL ATLAS

The department is providing all cartographic input to the New Zealand Historical Atlas, including maps, diagrams, graphs, photographs and text. This is being produced entirely within a PC environment, principally using CorelDraw software. The atlas, which is a new publication, is due for publishing in 1996.

PART 2: HYDROGRAPHIC ACTIVITIES OF THE ROYAL NEW ZEALAND NAVY (RNZN)

MONOWAI OPERATIONS

The large scale survey of the Bay of Islands commenced in 1990 and was completed in November 1992. This survey was completed ahead of schedule due in part to the utilisation of GPS for geodetic positioning of shore control. Other surveys carried out by MONOWAI during this time have included safe anchorages for cruise ships on the east coast of the environmentally sensitive sub-Antarctic Auckland Islands and GPS positioning of EEZ base points in the Kermadec Islands, which lie 600nm to the north-east of New Zealand. In 1993 MONOWAI carried out a series of large scale boat surveys in Auckland, Lake Taupo and at Penrhyn Island in the South Pacific Ocean. Shipping routes in the poorly charted Chatham Islands, which lie 360nm to the east of New Zealand, were also completed. In 1994 MONOWAI commenced the resurvey of Fiordland.

INSHORE SURVEY CRAFT (ISC) OPERATIONS

HMNZ Ships TARAPUNGA and TAKAPU supported MONOWAI in the Bay of Islands prior to undertaking surveys of the approaches, bars and harbours of Greymouth, Wanganui and Kaipara on the west coast of New Zealand during 1993. In 1994 the ISC are supporting MONOWAI's survey operations in Fiordland prior to commencing surveys in the Bay of Plenty.

DATA LOGGING AND PROCESSING

The introduction of the Hydrographic Automated Data Logging and Processing System (HADLAPS) in 1991 has been very successful. Within four weeks of acceptance, HADLAPS was being used operationally in the Bay of Islands and the introduction of a co-tidal model in 1993 has further enhanced the system's capability. The RNZN remains satisfied with the overall performance of HADLAPS, with one of the highlights being its user-friendly programs.

The introduction of HADLAPS has reduced the requirement for winter lie-ups which were necessary for data processing and hand drawing final sheets.

EQUIPMENT PROCUREMENT

The RNZN hopes to introduce differential GPS for positional control in the near future. This should reduce manpower requirements and increase productivity on the survey ground. The HF system HIFIX6 is beyond economic repair and the Del Norte microwave Trisponder system is presently the primary Navaid for positional control.

CHARTING AGREEMENTS

The signing of the charting agreement between Tonga and New Zealand in July 1993 is of particular significance. The agreement sees New Zealand supporting Tonga while the Kingdom develops its own hydrographic and cartographic capability. The charts, which are co-produced but printed in New Zealand, have both Tongan and New Zealand crests and numbers. The first chart, produced by a TDS cartographer in New Zealand, was published in October 1993.

CHART PRODUCTION

The modernisation and metrication of the New Zealand chart series has continued; the last British Admiralty chart of New Zealand home waters has been replaced. Two new charts of the Cook Islands have been produced and a third is in preparation.

New Zealand's contribution of eight charts to the medium scale international charting scheme of the SW Pacific has been completed. A large scale international charting scheme of the SW Pacific is now being considered.

A computerised chart production system designated SEACARTIS has been installed. The system is a version of the AUTOCHART system developed by the Royal Australian Navy Hydrographic Service. Based on the Hewlett Packard A990, it has three digitising workstations and two non-digitising workstations. The digitising stations are based on the Mackintosh Quadra 700 and Calcomp 9500 digitisers. All charts will in future be produced on SEACARTIS, enabling a digital chart database to be built up. When staff have more experience of the system, considerable time savings in production are expected.

Software has been purchased to enable data produced by HADLAPS and ocean sounding data currently held on master plotting sheets to be converted into MGD 77 format. This will enable New Zealand to conform to a policy decision of the IHO, that from 1996 its GEBCO ocean sounding data should be in digital format. It will also enable digital data held at the IHO Bathymetric Data Centre to be used more easily in chart production.

Notices to Mariners are now produced to print-ready stage using Microsoft Word on a Compaq 386, producing considerable cost savings. Databases of Vigias, Wrecks, Lights and other chart information are being developed.

Agreement has been reached with several companies for them to digitise/scan charts for use in electronic navigation systems.

Under consideration is the purchase of a GIS stand alone workstation for the investigation and development of electronic charting data suitable for shipborne Electronic Chart Display Information Systems (ECDIS).

Basic cartographic and on-the-job training in chart compilation and production has been provided in New Zealand for a Private of the TDS who produced the first TDS/NZ chart of Tonga while undergoing training. Currently a cartographer from the Fijian Hydrographic Office is receiving on-the-job training in chart compilation and production. Basic training in chart production procedures and techniques has also been given to officers of the Royal Malaysian Navy.